

**APPARATUS FOR MAKING ELECTRICAL CONNECTION TO A  
STEERING WHEEL CARRIED PORTION OF AN ELECTRICAL CIRCUIT.**

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Related Application Data

This application claims the benefit of U.S. provisional patent application No. 60/550,513, filed March 4, 2004, entitled, "Apparatus for Making Electrical Connection to a Steering Wheel Carried Portion of an Electrical Circuit", by Norman E. Ritchie, which is hereby incorporated by reference.

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Technical Field

The technology disclosed herein relates to making electrical contact between portions of one or more electrical circuits carried by the rotatable portion of a steering wheel and portions of such circuit which are coupled to or carried in part by a steering column such that they do not rotate as the steering wheel is turned.

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Background

It is desirable to maintain electrical contact between electrical conductors of one or more circuits carried by a rotatable steering wheel and electrical conductors of the circuits which do not move with the steering wheel.

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For example, a triggering signal for deployment of an air bag contained in a steering wheel is typically delivered electrically from an air bag control circuit to an air bag triggering circuit included in the steering wheel with the air bag. In this low power application, one is not concerned with delivering relatively high currents to the steering wheel.

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In one common approach, a so-called clock spring mechanism is used to make these electrical contacts. In a clock spring mechanism, a ribbon containing plural electrical conductors is wound into a roll or coil within a housing. The housing has one housing component coupled to the steering wheel and another housing component

mounted to the steering column with the two housing components being rotatable relative to one another. The ribbon conductor within the housing makes the connection between one or more electrical circuits carried in part by the steering column and corresponding electrical circuits carried by the steering wheel. The coiled  
5 connecting ribbon unwinds and becomes looser as the steering wheel is rotated in one direction. The coil in contrast winds tighter as the steering wheel is rotated in the opposite direction. The housing sections define a central opening through which a portion of the steering column extends with the coil winding and unwinding about the housing portions which define the steering column receiving opening. The housing  
10 sections snapfit together adjacent the central opening. A connection made by a coil conductor ribbon which is wound and unwound is thus one suitable approach in a number of applications. However, a need exists for an improved apparatus for these purposes.

15 Summary

The present invention is directed toward novel and non-obvious combinations and subcombinations of features disclosed herein for making electrical connections between one or more electrical circuits carried by a steering wheel and corresponding portions of such one or more circuits separated from the steering wheel, such as  
20 coupled to the steering column which supports the steering wheel for rotation.

In accordance with one embodiment, at least one electrically conductive annulus is carried by one housing section with at least a portion of the annulus surrounding a steering column receiving opening defined by the housing section. The annulus is electrically coupled to an electrical contact for electrical connection to one  
25 or more electrical conductors, such as via a connector, of a portion of an electrical circuit. At least one electrically conductive elongated finger is carried by another housing section. By electrically conductive, it is meant that the annulus and the finger provide an electrical path for the flow of current. Although not necessary, desirably

the entire annulus and the entire finger is electrically conductive. The finger is electrically coupled to another electrical contact which is designed to make electrical connection to one or more electrical conductors, such as via a connector, of another portion of the electrical circuit. The housing sections are rotatable relative to one another with one of the housing sections desirably being coupled to the steering wheel for rotating with the rotation of the steering wheel and the other housing section desirably being coupled to the steering column so as to remain stationary as the steering wheel is rotated. Upon assembly of the housing sections, the finger, and desirably a finger contact pad portion thereof, slides in contact with an electrical contact surface of the annulus to maintain electrical connection between the two electrical contacts and associated conductors and circuit portions as the steering wheel is rotated.

In one desirable form, the annulus comprises an electrical contact surface facing toward the interior of a chamber defined by the housing sections. In a specific form, the electrical contact surface extends three hundred and sixty degrees about the center of a steering column receiving opening defined by the housing sections. In a specifically desirable form, the electrical contact surface is planar.

The annulus may comprise a body with a first contact tab projecting from the body in a direction away from the interior of the chamber. One of the housing sections supports the annulus and comprises a first contact tab receiving opening through which the first tab extends to make the first tab accessible from the exterior of the supporting housing section. The first tab in this form comprises the first electrical contact. The body of the annulus may also comprise a plurality of crimping tabs with the supporting housing section having a plurality of crimping tab receiving openings. The crimping tabs respectively extend in the exterior direction through the respective crimping tab receiving openings and are crimped at the exterior of the supporting housing section to retain the annulus in position relative to the annulus supporting housing section. Desirably, the annulus, including the body, first tab and crimping

tabs, is formed from a planar sheet of electrically conductive material. The body may be in the shape of a ring.

The finger is desirably arcuate in shape and extends from a housing section which supports the finger toward the housing section which supports the annulus. The  
5 finger desirably comprises a base which is mounted to an interior surface of the finger supporting housing section. In a specifically desirable form, the finger extends through an arc in excess of ninety degrees about the center of the steering column receiving opening. The finger desirably comprises a resilient member. By resilient, it is meant that the finger has some memory. That is, when the finger is deflected in one  
10 direction, a reaction force exists in the opposite direction and urges the finger toward its original position. The finger, and in one specific form a finger contact pad portion, engages the annulus and is deflected toward the housing section which supports the finger as the housing sections are assembled. As a result, the finger is biased toward an electrical contact surface of the annulus.

15 In a specifically desirable form, the finger comprises a body. The body may comprise a second contact tab which extends in an exterior direction. The finger supporting housing section desirably defines a second contact tab receiving opening through which the second tab projects. The second tab may comprise the second electrical contact. The finger may also comprise a base portion mounted to the interior  
20 surface of the finger supporting housing section. The base portion is desirably shorter than the length of the finger. The second tab may project from the base portion. In one desirable embodiment, the entire finger including the base portion, the body and second tab is formed from a single sheet of electrically conductive material, except for a finger contact portion, if included.

25 Plural fingers and plural annuli may be included for the purpose of making electrical contact with plural circuits.

These and other features and advantages of embodiments will become apparent from the disclosure set forth below and from the accompanying drawings.

### Description of the Drawings

Fig. 1 is a perspective view of one form of a modular electrical contact maintaining apparatus looking upwardly toward a lower housing section included in the embodiment.

5 Fig. 2 is a perspective view of the embodiment of Fig. 1 looking downwardly toward an upper housing section included in the embodiment.

Fig. 3 is a view of an interior portion of the embodiment of Fig. 1 with the lower housing section removed.

10 Fig. 4 is a view of an interior portion of the embodiment of Fig. 2 with the upper housing section removed.

Fig. 5 is a vertical sectional view through an embodiment of an electrical contact maintaining apparatus.

Fig. 6 is an exploded view of an embodiment of an electrical contact maintaining apparatus.

15 Fig. 6A is an exploded view of portions of an alternative embodiment of an apparatus for maintaining electrical contact between a plurality of electrical circuits.

Fig. 7 is a perspective view illustrating an exemplary approach for mounting the embodiment of Fig. 1 to a steering column and steering wheel of a vehicle.

### 20 Detailed Description

With reference to the figures, Fig. 1 illustrates a modular apparatus for maintaining electrical contact between an electrical conductor of a portion of a circuit coupled to a steering column of a vehicle and an electrical conductor of another portion of the circuit carried by the steering wheel of the vehicle. In the form shown in Fig. 1, the apparatus comprises housing sections 12,14. When assembled as shown in Figs. 1 and 2, the housing sections 12,14 define a steering column receiving opening 16 through the center thereof through which a portion of a steering column may be inserted. In the embodiments of Figs. 1 and 2, housing section 14 comprises a lower housing section which is configured for coupling to the steering column. More

specifically, spaced apart detachable fasteners 20,22 and 24, such as screws, are received through associated mounting projections 26,28 and 30. Fasteners 20,22 and 24 are received by a bracket 32 (Figs. 5 and 7), which is carried by the steering column to thereby mount housing section 14 to the bracket. Thus, the housing section 14 is coupled to the steering column such that housing section 14 is maintained in a stationary relationship relative to the steering column and relative to the steering wheel as the steering wheel is rotated or turned. An exemplary steering wheel 40 is shown in Fig. 7.

Referring again to Figs. 1 and 2, the upper housing section 12 in this embodiment is provided with respective spaced apart fastener access openings 46,48 and 50. The openings 46,48 and 50 are aligned with the respective bosses 22,24 and 26 to provide access to the fasteners 20, 22 and 24 for purposes of allowing the tightening and loosening of the fasteners to and from the steering column mounting bracket while the housing sections 12,14 are in an assembled state.

The illustrated housing sections 12,14 are of a generally circular shape. When the housing sections are assembled, they define an interior chamber 60 (Fig. 5) that is generally hollow. As can be seen in Fig. 5, housing section 12 has a base 62 and a perimeter wall 64 which projects outwardly from the base in a direction toward the housing section 14. In addition, the housing section 12 also comprises an interior wall 66 which projects in the same direction as wall 64 to define a portion of the steering column receiving opening 16. Base 62 of housing section 12 has an interior major surface 68 which faces the interior of chamber 60 and an exterior surface 70 opposed to the interior major surface. The illustrated form of housing section 14 comprises a base 74 having a perimeter wall 76 which projects from base 74 and toward the housing section 12. In addition, housing section 14 comprises an interior wall 78 which projects toward housing section 12 in the same direction as wall 76. The wall 78, like the wall 66, is desirably generally circular in shape. Although this form of housing is desirable, other forms may also be used. In addition, each of the housing sections 12,14 may be of a plural piece construction. However, in the form illustrated,

each housing section is of a monolithic single piece unitary construction such as being molded of a durable plastic material.

A rotation guiding groove 80 (Fig. 5) is provided in wall 66 and faces the wall 78. Although not required, the groove 80 desirably extends substantially about the entire periphery of wall 66. Groove 80 defines a circular guide path for receiving one or more guides on the housing section 14, such as one or more snapfit connectors. In the illustrated embodiment, at least one snapfit connection 82 projects from wall 78 toward wall 66. When the housing sections 12,14 are assembled, snap fit projection 82 is received in the groove 80. In the form shown in Fig. 4, there are three such snap fit projections 82 (two being shown in Fig. 4). Each of the projections 82 extends through an arc which desirably is in excess of sixty degrees. Although the housing sections may be separately supported or interconnected in other ways, the depicted snap fit interconnection allows housing section 12 to rotate relative to housing section 12 as the steering wheel is turned.

In one convenient approach, a clip connection 86 projects outwardly from base 62 of housing section 12 and is provided for insertion into a clip receiving slot (not shown) in the underside of the steering wheel. Clip connection 86 provides a biased connection to reduce rattle of the housing section 12 relative to the steering wheel. That is, the upwardly projecting legs which form clip 86 are compressed toward one another as the clip 86 is inserted into a clip receiving slot of the steering wheel. Other mechanisms for coupling housing section 12 to the steering wheel may also be used.

One of the first and second housing sections 12,14 carries at least one electrically conductive annulus. The annulus may be carried by either of the housing sections but, in the embodiment shown in Figs. 3-6, an annulus is carried by housing section 12. One specific form of annulus is indicated at 100 in these figures. The illustrated form of annulus 100 comprises a body portion 110 which may be in the form of a ring. The body portion 110 is desirably positioned such that at least a portion of the body is concentric with the axis about which the steering wheel rotates. An electrical contact, such as an elongated finger contact, one form being indicated at

102 in these figures, carried by the other of the housing sections, in this example by the housing section 14, is maintained in contact with a portion of the body 110 of annulus 100 as the steering wheel is rotated. That is, electrically conductive elongated finger 102 may have an electrically conductive contact pad 104 which is maintained at  
5 a constant radius relative to the axis about which the steering wheel rotates. The radial position of contact pad 104 matches the radius of at least a portion of the annulus 100 such that contact pad 104 remains in contact with such portion of the body of the annulus as the steering wheel is rotated. It should be noted that, a highway truck steering wheel is often rotated completely around the steering wheel axis a plurality of  
10 times to sharply turn the truck

Desirably, the annulus 100 comprises a body 110 which may be of a ring configuration. The illustrated body has a planar electrical contact pad engagement surface 112 which faces the interior of the chamber 60 defined by the first and second housing sections 12,14 when the housing sections are assembled. The body 110 may  
15 be mounted to the housing section 12 in any convenient manner such as using fasteners or the like. However, in the illustrated embodiment, body 110 comprises a plurality of spaced apart radially inwardly projecting crimping tabs, such as tabs 114 (two of which are numbered in Fig. 6) spaced ninety degrees apart. The housing section 12 comprises a plurality of crimping tab receiving openings such as slots, two  
20 of which are indicated at 116 in Fig. 6. Prior to crimping, each tab 114 includes an upwardly projecting portion which is inserted through the corresponding associated slot 116. Following insertion, the tabs 114 are bent backwardly (as shown in Fig. 6) to crimp the base 62 of housing section 12 between upper and lower portions of the crimping tabs. Fig. 5 illustrates two of the crimping tabs positioned in crimping tab  
25 receiving openings 116 (in Fig. 5 the openings 116 are spaced closer to the center of housing section 12 than shown in Fig. 6). Fig. 5 illustrates an example of the crimping tabs 14 being bent back on themselves to crimp against respective portions of surfaces 68,70 of housing section base 62. That is, the base 62 is inserted between sections of the crimping tabs 114 following the insertion of each crimping tab through



corresponding associated slot 116. With this mounting approach, the annulus 100 is securely carried by housing section 12 so as to not rotate relative to the housing section.

In addition, the illustrated annulus 100 comprises an upwardly projecting  
5 electrical contact 120 which is positioned to extend upwardly through a contact receiving opening 122 (Fig. 3) extending through base 62 of housing section 12. For protection and connection purposes, contact 120 may be at least partially surrounded by a connector housing 124 projecting upwardly from the upper surface 70 of the housing section 12 (see Figs. 2 and 5). An electrical connector 126, electrically  
10 connected to an electrical conductor 128, may be inserted into housing 124 and into electrical engagement with the contact 120. Although not shown, connector 126 and housing 124 may be configured to detachably engage one another, if desired, to assist in maintaining the electrical contact between conductor 128 and contact 120. Desirably, annulus 100 is formed from a single sheet of material and thus the annulus  
15 100 in this form is of a monolithic one-piece construction. A durable electrically conductive contact material may be used for annulus 100, such as a copper alloy.

The illustrated electrical contacting finger 102 comprises an elongated body 140 which is desirably arcuate in shape. Body 140 comprises a base portion 142 and a  
20 distal end portion 144 with the electrical contact pad 104 being carried by distal end portion 144. The body is elongated from base 142 to distal end portion 144 and in the form shown desirably extends through an arc which in excess of ninety degrees about the axis of rotation of the steering column. The axis of rotation of the steering wheel is centered in opening 16. A portion of the axis of rotation of this steering wheel is indicated by the dashed line 146 in Fig. 5 and Fig. 6. The finger 102 also desirably  
25 comprises an electrical contact which may, as illustrated in Fig. 6, comprise a tab 150 which projects from base 142 in a direction away from the housing section 12. A contact receiving opening, such as slot 152, may be provided through the base 74 of housing section 14. Electrical contact 150 may be inserted through slot 152. In Fig. 1, an exemplary contact 150 is shown exposed following insertion through the slot in

base 74 of housing section 14. In Fig. 5, a contact surround 156 projects outwardly from the undersurface of base 74 of housing section 14 and at least partially surrounds the contact 150. Surround 156 has a hollow interior into which contact 150 projects. An electrical connector 158, which is electrically connected to conductor 160 of a circuit, is inserted into surround 156 and into electrical engagement with the contact 150. Although not shown in Fig. 5, connector 158 and connector receiver 156 may detachably engage one another to facilitate the maintenance of the electrical connection between contact 150 and conductors 160. The base 142 of finger 102 may be fastened to the housing section 14 in any convenient manner such as using fasteners. In the illustrated embodiment, base 142 may include a plurality of pin receiving openings (not shown in Fig. 6) for receiving mounting pins (one of such pins is indicated at 162 in Fig. 4) through the pin receiving openings. The base 162 may be soldered, pressfit, or otherwise secured to the pins 162.

Desirably, the finger 102 is formed of a resilient material such that deflection of the finger (such as toward housing section 14) results in a reaction force in the opposite direction, such as indicated by arrow 170 in Fig. 5. The elongated body portion 150 of finger 102 is designed to extend upwardly from base 142 to a position which is above the location of housing section 12 prior to the assembly of housing sections 12 and 14. Consequently, when housing sections 12 and 14 are interconnected, body 140 is deflected downwardly with the result being that pad 104 is biased upwardly against the electrical contact surface 112 of ring 100 (see Fig. 5). This assists in maintaining the electrical contact between contact pad 104 and ring 100 and thus between the conductors 128 and 160 of the respective circuit portions.

Desirably, all portions of finger 102 except the contact pad 104 are formed of a single sheet of material and thus finger 102, with the exception of contact pad 104, is of a monolithic one-piece construction. For example, finger 102 may be formed of an electrically conductive metal such as a copper alloy. Contact pad 104 may be formed, for example, of a copper alloy or a nickel-copper alloy and soldered, brazed or otherwise secured to distal end 144 of the body 140.

Fig. 6A illustrates an embodiment wherein a plurality of steering wheel carried circuits are electrically connected to other components of such circuits which are at a location which is separate from the rotatable steering wheel. In the embodiment of Fig. 6A, the contact 120 is electrically connected by conductor 128 to a horn activating switch 130 on the steering wheel and by conductor 160 to a horn circuit 132. When switch 130 in the Fig. 6A embodiment is closed, the horn circuit 132 is activated and the vehicle horn sounds.

In Fig. 6A, a second annulus 100' and second finger 102' is included in the construction. Corresponding elements to those previously shown in the embodiments of Figs. 1-6, are designated by the same numbers in Fig. 6A with a "prime" designator. For this reason, these elements will not be described in detail. In the embodiment of Fig. 6A, annulus 100' is concentric with annulus 100 and is electrically isolated from the annulus 100. The diameters of the respective annuli 100, 100' may be reduced such that these components fit within a housing which is dimensionally the same as the housing formed by the housing sections shown in Figs. 1 and 2. In the embodiment of Fig. 6A, the finger 102' and annulus 100' make electrical contact to a different electrical circuit that is in part carried by the steering wheel and in part separated from the steering wheel. For example, the steering wheel may carry a resistive heater 170 that extends about the entire periphery or portions of the periphery of the steering wheel for purposes of heating the steering wheel when initially used and the cab of the vehicle containing the steering wheel is cold. In this embodiment, the conductor 160' is coupled through a steering wheel heater control switch 172 to a power supply 174. It should be noted that the circuits described in Fig. 6A are simply for the purposes of illustrating the concept as these circuits may vary from those depicted and alternative circuits may be used. These types of circuits may carry greater electrical currents than, for example, carried by circuits which deliver control signals, such as air bag triggering signals. More than two annuli and fingers may be included if additional circuits or conductors are carried by the steering wheel and

desirably are to be coupled to circuit portions that are separated from the steering wheel.

Having illustrated and described the principles of my invention with reference to several embodiments, it should be apparent to those of ordinary skill in the art that  
5 the invention may be modified in arrangement and detail without departing from such principles. I claim all such modifications as fall within the scope and spirit of the following claims.